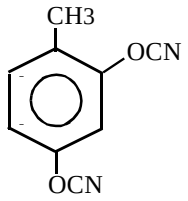
2,4-TOLUENE DIISOCYANATE

2,4-Toluene diisocyanate is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 584-84-9

Molecular Formula: $C_9H_6N_2O_2$



2,4-Toluene diisocyanate is a clear to pale yellow liquid with a sharp, pungent odor (NTP, 1991). 2,4-Toluene diisocyanate is miscible with alcohol (decomposition), diglycol monomethyl ether, ether, acetone, carbon tetrachloride, benzene, chlorobenzene, kerosene, and olive oil. It reacts with water with the evolution of carbon dioxide (Merck, 1989). 2,4-Toluene diisocyanate is also combustible when exposed to heat or flame, and darkens when exposed to light (NTP, 1991).

Physical Properties of 2,4-Toluene Diisocyanate

Synonyms: 2,4-tolylene diisocyanate; m-tolylene diisocyanate; TDI; 2,4-diisocyanatotoluene; Nacconate 100; toluene diisocyanate; 2,4-diisocyanato-1,1methylbenzene

Molecular Weight:	174.15
Boiling Point:	251 °C
Melting Point:	19.5 - 21.5 °C
Flash Point:	132 °C (270 °F) (open cup)
Vapor Density:	6.0 (air = 1)
Density/Specific Gravity:	1.2244 at 20/4 °C (water = 1)
Vapor Pressure:	0.01 mm Hg at 20 °C
Conversion Factor:	1 ppm = 7.12 mg/m^3

(Howard, 1990; HSDB, 1991; Merck, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

2,4-Toluene diisocyanate is used to produce polyurethane foam product and coatings, sprays, insulation materials, and polyurethane foam coated fabrics (HSDB, 1991; U.S. EPA, 1994a).

The primary stationary sources that have reported emissions of 2,4-toluene diisocyanate in

California are stone, clay, and glass products, manufacturers of miscellaneous plastic products, and petroleum refining (ARB, 1997b).

B. Emissions

The total emissions of 2,4-toluene diisocyanate from stationary sources in California are estimated to be at least 32,000 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

No information about the natural occurrence of 2,4-toluene diisocyanate was found in the readily-available literature.

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of 2,4-toluene diisocyanate.

INDOOR SOURCES AND CONCENTRATIONS

Potential indoor sources of 2,4-toluene diisocyanate include polyurethane coatings, cement sealers, polyurethane mastic sealants, and polyurethane cushions and pads (Hodgson and Wooley, 1991). Eight different bonded-urethane and prime-polyurethane carpet pads were tested for 2,4-toluene diisocyanate emissions. A very low emission (0.07 micrograms per square meter per hour) of 2,4-toluene diisocyanate was detected from only one pad, but a test of a duplicate sample of this pad did not detect any emissions (Hodgson and Phan, 1994).

ATMOSPHERIC PERSISTENCE

2,4-Toluene diisocyanate will be removed from the atmosphere from its reaction with photochemically-produced hydroxyl radicals. The rate constant measured by Becker et al. (1988) for the hydroxyl radical reaction with a mixture of 2,4-toluene diisocyanate (80 percent) and 2,6-toluene diisocyanate (20 percent) leads to a calculated half-life of 1.4 days (Atkinson, 1995). 2,4-Toluene diisocyanate will also be removed from the atmosphere through dry deposition (Howard, 1990).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program. Of the risk assessments reviewed as of April 1996, 2,4-toluene diisocyanate contributed to the total cancer risk in 2 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million.

2,4-Toluene diisocyanate also contributed to the total cancer risk in 2 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million (OEHHA, 1996a).

For non-cancer health effects, 2,4-toluene diisocyanate contributed to the total hazard index in 2 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 1 of these risk assessments. (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to 2,4-toluene diisocyanate are inhalation and dermal contact.

Non-Cancer: 2,4-Toluene diisocyanate is a potent respiratory tract sensitizer. 2,4-Toluene diisocyanate is extremely toxic from acute and chronic exposure. Acute inhalation exposure to high levels in humans causes severe eye, skin, and respiratory tract irritation (U.S. EPA, 1994a). Exposure to 2,4-toluene diisocyanate even at very low levels may cause sensitization such that subsequent exposure to minute amounts results in severe immune responses. Also, cross-sensitization may occur when individuals exposed to 2,4-toluene diisocyanate are subsequently exposed to related isocyanate compounds (HSDB, 1991). Chronic inhalation exposure in humans has caused an asthmatic allergic reaction with symptoms of shortness of breath, wheezing, and bronchial constriction. Effects on the liver, blood, and kidneys have been observed (U.S. EPA, 1994a). Exposure does not have to be through inhalation to provoke respiratory system effects (HSDB, 1991).

A chronic non-cancer Reference Exposure Level (REL) of 0.095 micrograms per cubic meter ($\mu g/m^3$) is listed for 2,4-toluene diisocyanate in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for chronic toxicity is the respiratory system (CAPCOA, 1993). The Reference Concentration (RfC) is under review by the United States Environmental Protection Agency (U.S. EPA), and no Reference Dose (RfD) has been set (U.S. EPA, 1994a).

No information is available on adverse reproductive or developmental effects in humans or animals (U.S. EPA, 1994a).

Cancer: No information is available on the carcinogenic effects of 2,4-toluene diisocyanate. Increased incidences of tumors have been reported in test animals exposed to 2,4-toluene diisocyanate. The U.S. EPA has not classified 2,4-toluene diisocyanate for carcinogenicity (U.S. EPA, 1994a). The International Agency for Research on Cancer (IARC) has classified 2,4-toluene diisocyanate as Group 2B: Possible human carcinogen based on sufficient evidence in

animals (IARC, 1987a).

The State of California has listed toluene diisocyanate (CAS Registry Number 26471-62-5) as a carcinogen under Proposition 65 (CCR, 1996). The recommended inhalation potency value for use in cancer risk assessments is 1.1×10^{-5} (microgram per cubic meter)$^{-1}$. In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 $\mu g/m^3$ of toluene diisocyanate is estimated to be no greater than 11 in 1 million. The recommended oral potency value for use in cancer risk assessments is 3.9×10^{-2} (milligram per kilogram per day)$^{-1}$ (OEHHA, 1994).